

Temporary Refuge Concepts

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What a Temporary Refuge is?

TEMPORARY REFUGE DEFINITION

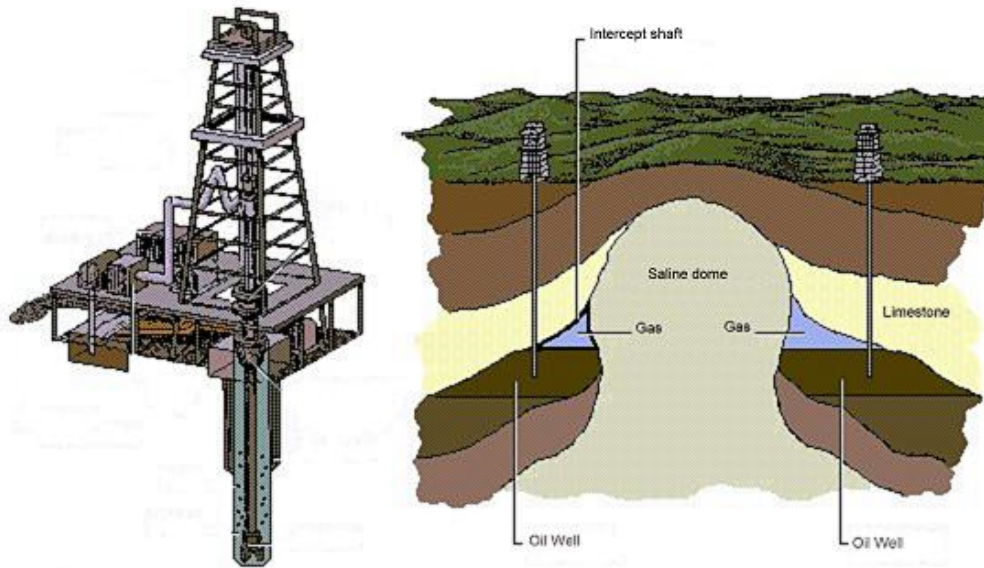
The Temporary Refuge (T.R.) is a safe and **sealed** area for the people protection during environmental contamination from poisonous gases which can be present in operating areas where oil and/or gas research, extraction and pre-production are performed.

The environmental conditions inside T.R. are constantly monitored to avoid the presence of contaminated air.

Which kind of dangers are prevented?

Contamination related to the oil and/or gas research, extraction and pre-production comes from the presence of toxic and/or explosive gases in the environment.

This presence could be related to the escape of gas from drilling wells, from piping or storage/production facilities or to the production of toxic gases due to an explosion in the surrounding area.



Which kind of dangers are prevented?



The T.R. facility needs to be designed with the following minimal characteristics:

- **have an area sealed from external air infiltrations**
- **have a structure able to resist to nearby explosions without losing integrity and tightness**
- **have the capacity to assure the breathability of air inside protected area for a defined time needed to keep safe all personnel on board until the arrival of rescue transportation means (boats, trucks, ect.) or until the return of external air to a safe condition.**

What a Temporary Refuge is?

This is achieved inside the sealed T.R. area as follows:

- fully recirculated air conditioning system
- safe area in overpressure respect to the external
- entrance in the safe area protected by airlocks

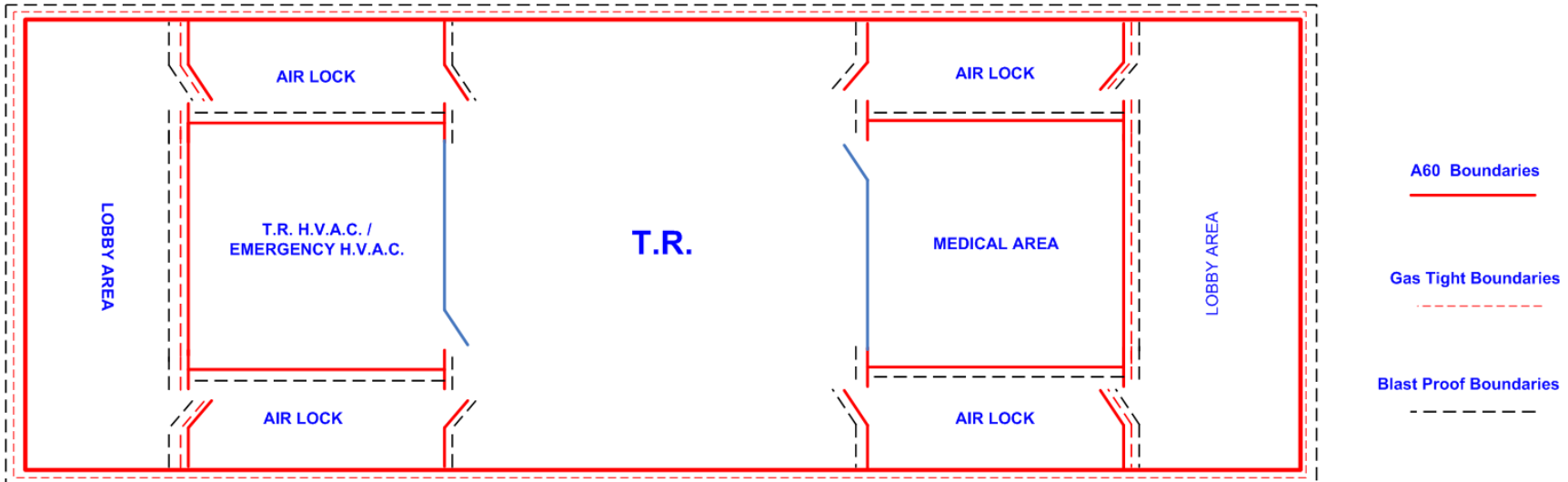
The following equipments are installed inside TR:

- a reserve of breathable air
- a reserve of oxygen
- a CO2 reduction system

To maintain the correct required oxygen ration and to prevent the increase of carbon dioxide ratio inside T.R. a reserve of breathable air and oxygen and a CO2 reduction system are installed inside the T.R.



The Temporary Refuge typical layout



The temporary refuge consists in:

- a large area able to contain the personnel on board (could be the mess-room of the vessel) the minimum surface of this area will need to be of 1,5 sq.m per person
- two or more airlocks equipped with air washing systems and interlocked doors
- a fully recirculated air conditioning system area
- a medical area (the vessel infirmary, for instance)

Temporary Refuge typical emergency equipment

TR will be equipped with the following safety systems:

- **TR Control/Command Panel including Gas Level Monitoring Console and the residual levels of air and oxygen in the air/oxygen bottles of the TR system**
- **ESD/F&G Console Unit: Emergency Shut-Down and Fire & Gas console**
- **Smoke detectors**
- **Fire detectors**
- **Gas detectors**
- **PA/GA Access Point**
- **Telephone Access Point**
- **Communication point into each Air-Lock**
- **A CCTV system**

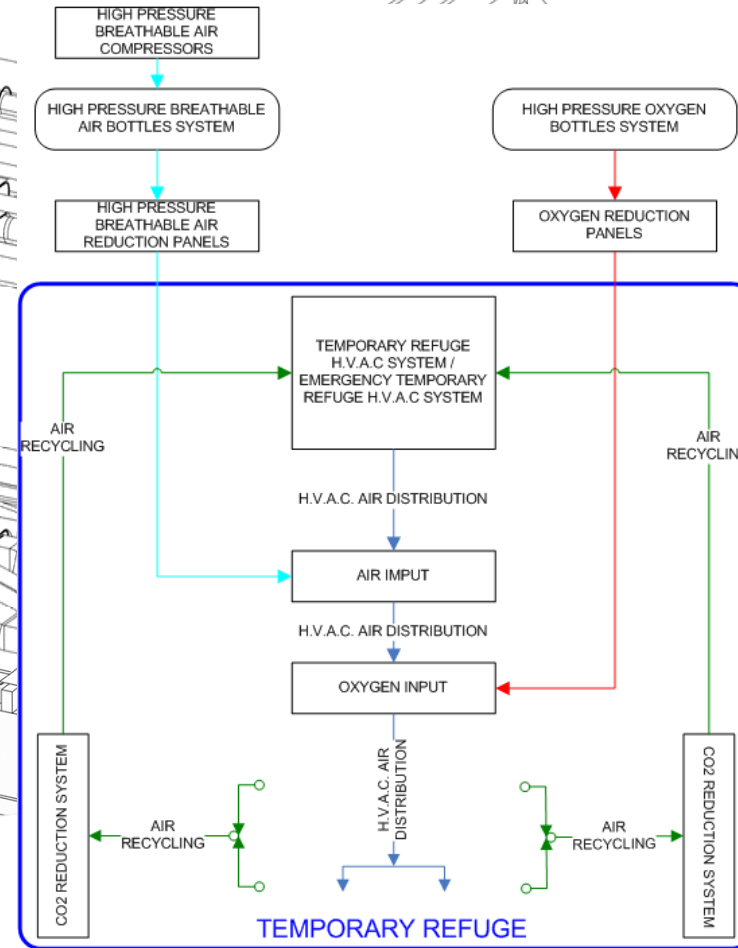
Air and O2 supply – 1/2

TR will be a sealed environment, according with the same rules in use on submarine units, based on the following main concepts:

Air will be provided by systems of high pressure air bottles. The storage system is made up with litres high pressure bottles with first and second stage pressure reduction stations, distribution system, air compression system to ensure the capacity of filling the bottles with clean air.

The complete TR survival system is based on 100% back-up systems for O2, while the air supply system is based on three 50% back-up modules: in this way we achieve the minimal survival level, reducing the quantity of high pressure air bottles required.

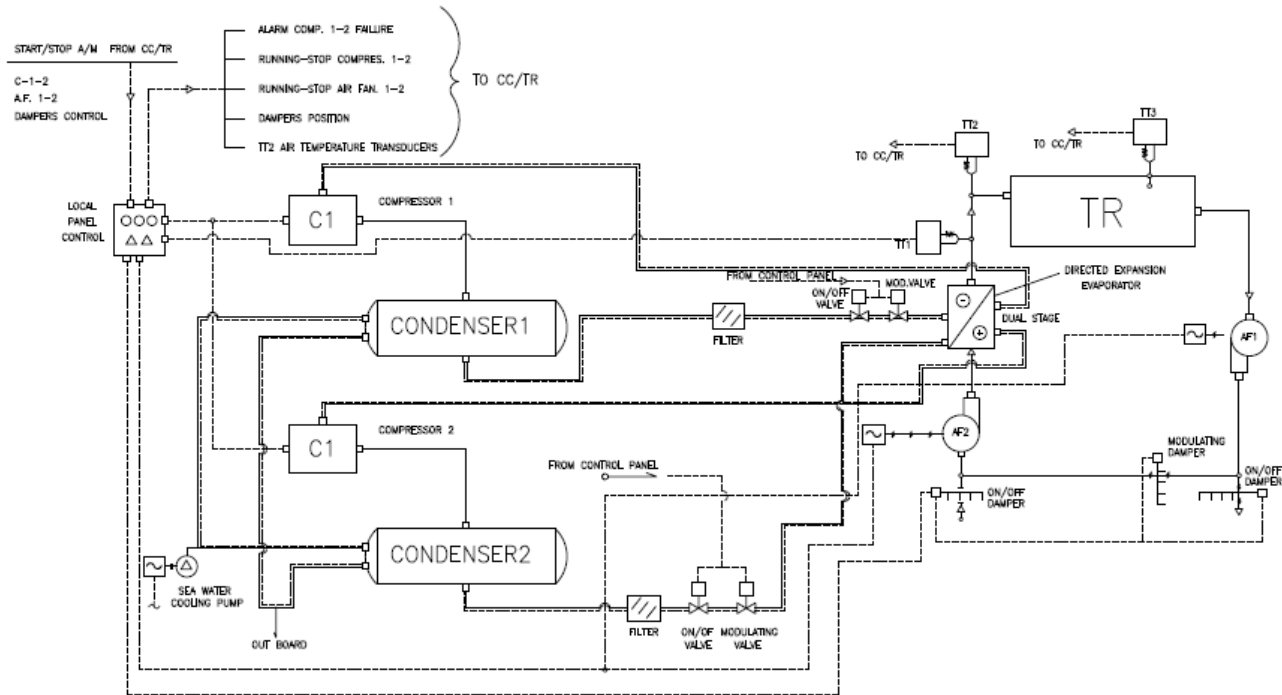
Air and O2 supply – 2/2



Temporary Refuge Emergency H.V.A.C. 1/2

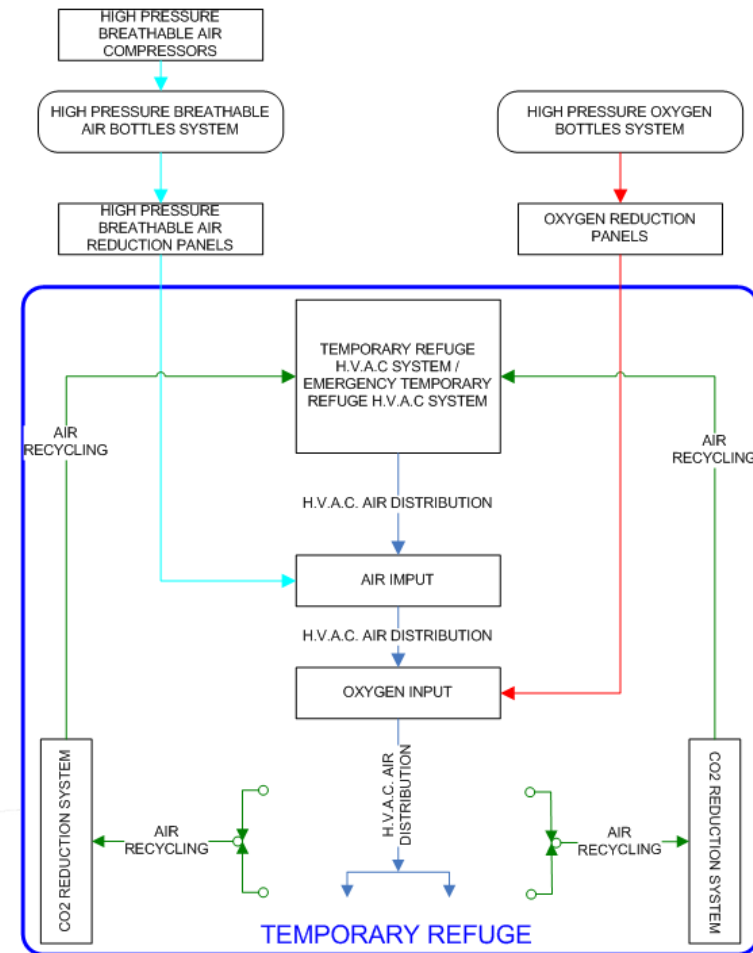
The second needed thing to assure that the T.R. internal environment is safe is to realize an HVAC system without external fresh air.

This kind of system needs a continuous monitoring of CO2 percentage inside T.R. and one dedicated CO2 removal system and an O2 controlled supply system.



Temporary Refuge Emergency H.V.A.C. 2/2

For this purpose a series of compressors stores compressed fresh air inside dedicated bottles, a O2 reserve is present on board and a CO2 Filtering system is installed.



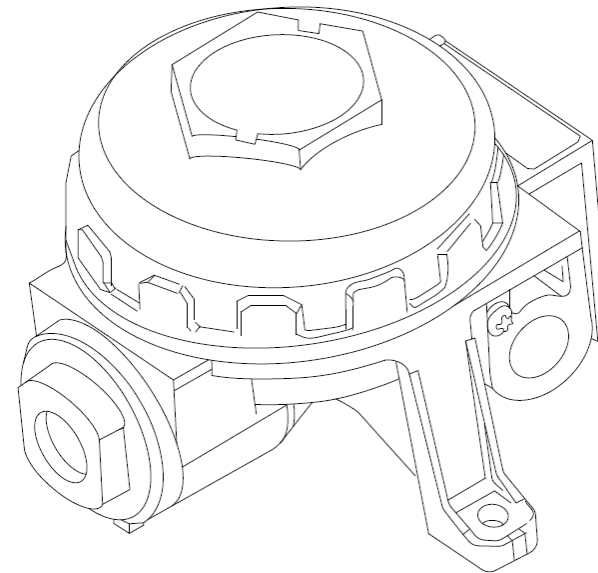
The gas detection system 1/2

The gas detection system is equipped with a series of sensors placed in various strategic locations all around the vessel.

In particular the gas monitoring is performed inside of T.R., inside of air locks, immediately on the external of air locks and in a series of location defined to cover all vessel surface.

Typical sensor array is composed by SO₂ sensor, CH₄ sensor and H₂S sensor; where needed also CO₂ sensor and O₂ sensor are installed.

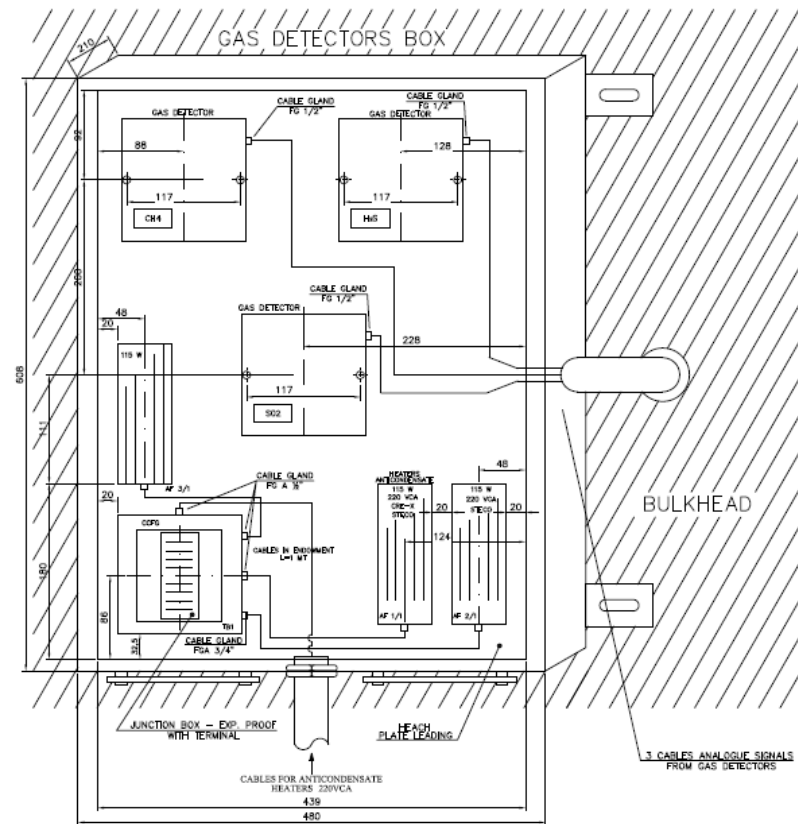
When installed externally the arrays are installed inside of temperature controlled protection boxes.



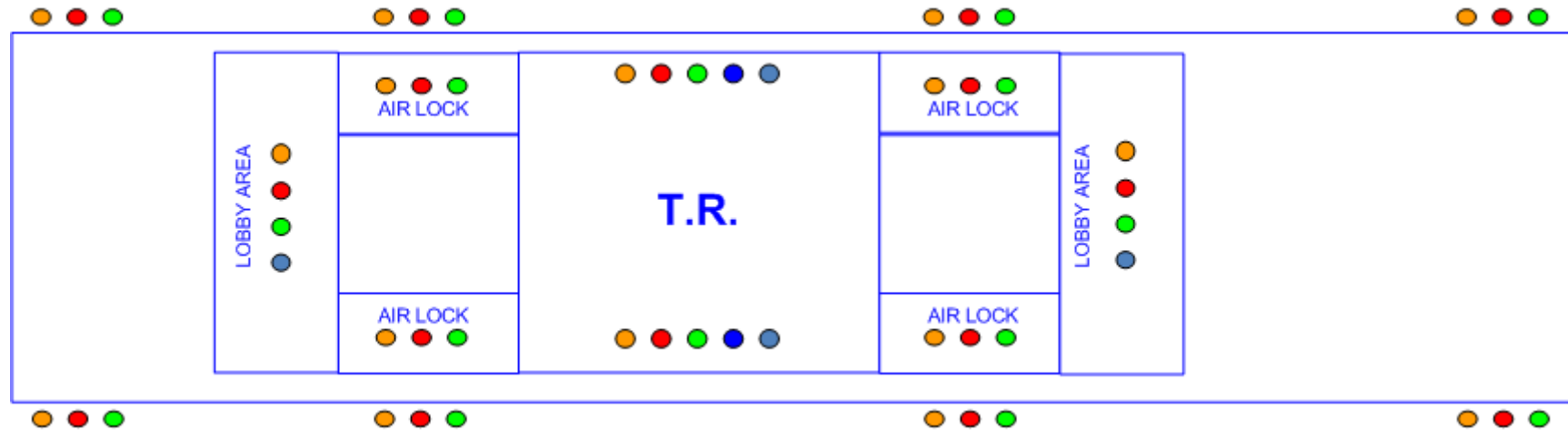
The gas detection system 2/2

The gas detection system is equipped with a series of sensors placed in various strategic locations all around the vessel.

In particular the gas monitoring is performed inside of T.R., inside of air locks, immediately on the external of air locks and in a series of location defined to cover all vessel surface.



Typical sensors positioning



- SO2 sensor
- CH4 sensor
- H2S sensor
- CO2 sensor
- O2 sensor

Sensors arrays can be equipped with one or three sensors of each type according to requirements.

When two or more sensors of the same type read high values of gas the alarm status is achieved and emergency procedure is started

Airlock

To prevent the pollution of T.R. environment the first requirement is to seal the safe area from external to avoid that personnel entering the T.R. brings dangerous gases inside it.

To respect this requirement T.R. entrance is designed to maintain the external environment and the internal environment completely isolated one from the other.

These Airlocks are equipped with interlocked doors and a series of grilles.

When the external door is opened an air curtain above it prevents external air from entering the airlock; soon as the external door is closed and personnel entered the airlock a clean air flow starts to wash the internal volume of airlock and the personnel dresses from the presence of dangerous gases.

Only after the washing procedure the internal door of airlock opens to allow the entrance inside T.R. safe area.



Vessel Monitoring System

The Vessel Monitoring System is a redundant automatic system which performs sensor monitoring and alarm management related to the gases detection system.

The Monitoring System, due to its essential importance, is designed to prevent failures of hardware or software during critical events and it's protected from events such as explosions or power loss.

A continuous monitoring of gas sensors is performed to assure the safety of the vessel environment and the management of critical events such as toxic or explosive gases escapes.

Also the internal of T.R. is monitored to manage the functionalities of dedicated HVAC system assuring, during alarms, the safety of the internal environment with a continuous verification of CO₂ percentage to assure the breathability of air.

The system is integrated in the T.R. control console installed inside of T.R.

T.R. control console

Through the T.R. control console all vital operations during alarms can be performed from inside the safe area of T.R.

The console consists of an environment monitoring system, an alarm history panel, a CCTV system to monitor the T.R. accesses and a control panel which indicate the power sources availability and allows operations such as:

- Manual start of level 1 and level 2 alarms
- Reset of system after alarm
- Set system for training and maintenance
- Alarm silencing

Also a communication system is integrated to the console.



The Emergency procedure

Three levels of alarm and associated emergency operation modes of the TR shall be foreseen:

- **Alarm level 1;**
- **Alarm level 2;**
- **Gas Detection.**

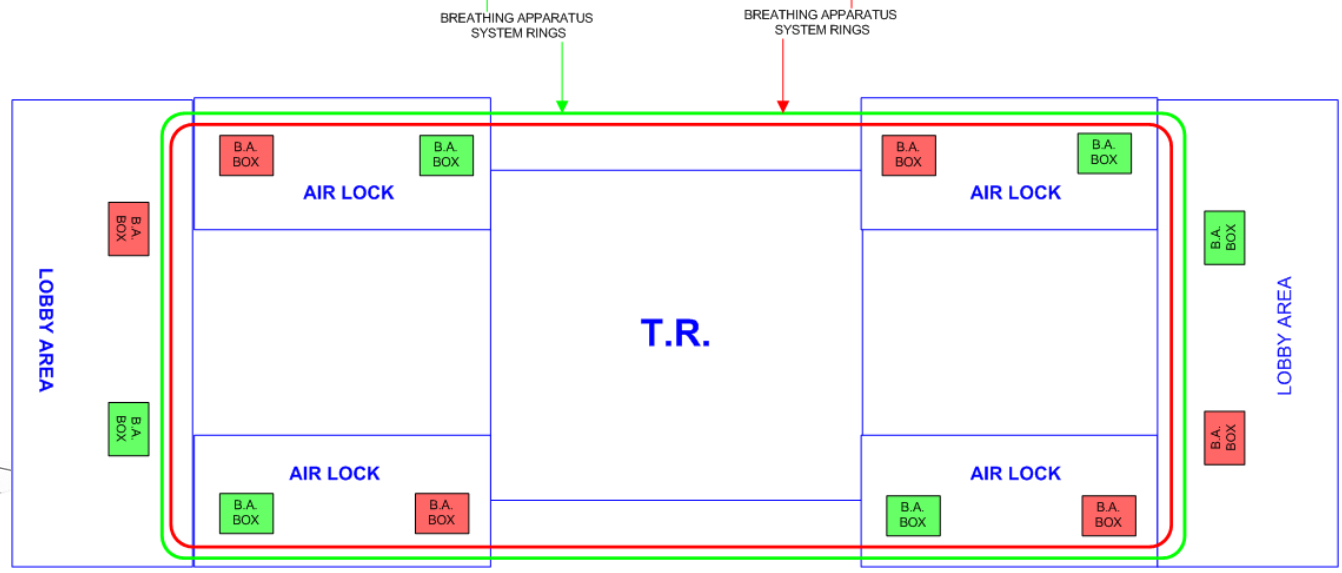
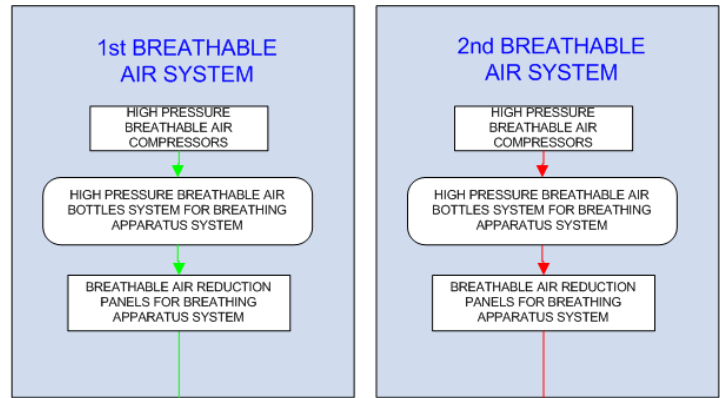
'Alarm 1': emergency status responding to the situation where no gas is present on board, and General alarm/notification has been received from an external source (e.g. notification from the drilling island) about a situation potentially impacting the vessel

'Alarm 2': emergency status responding to the situation where gas presence on surface has been received from an external source (e.g. notification from the drilling island), so that an imminent or immediate contamination by flammable and/or toxic gases is expected on board the vessel

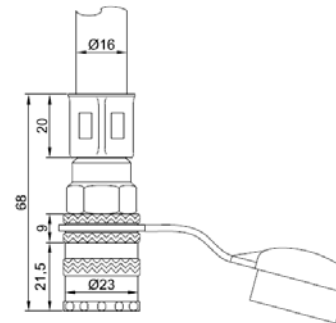
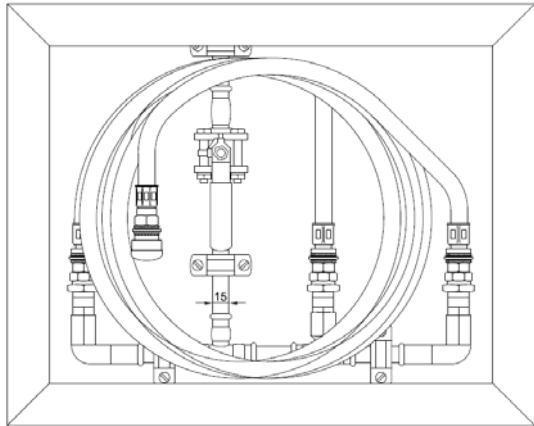
'Gas Detection': emergency status responding to the situation where gas presence has been detected on board the vessel.

Breathing Apparatus System 1/2

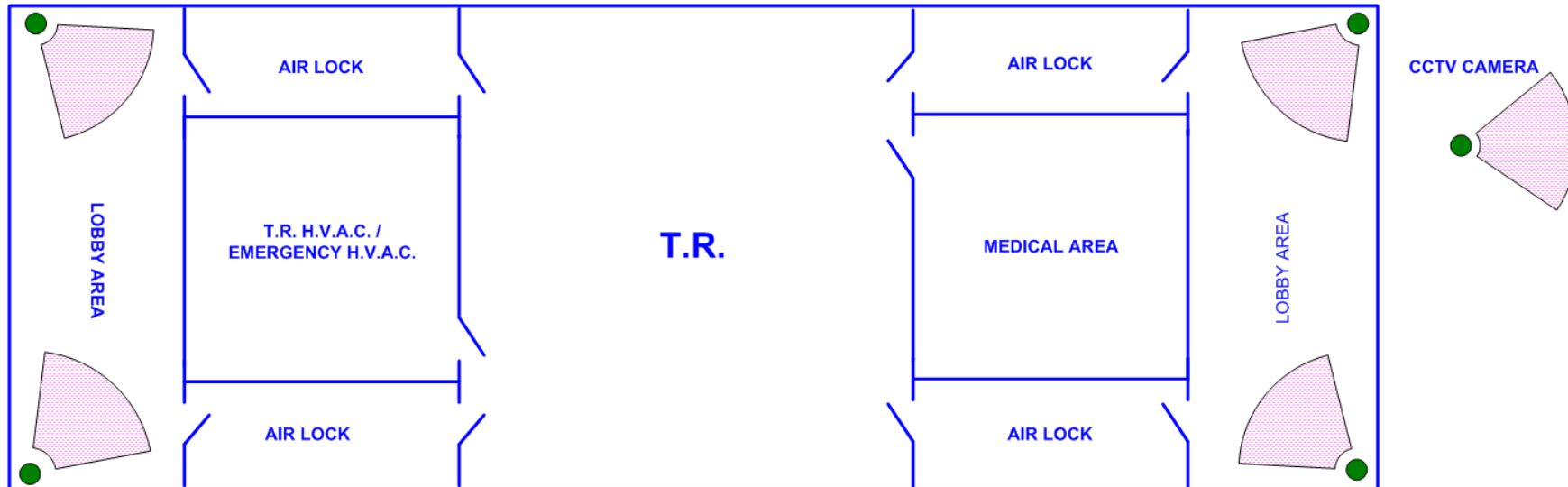
Emergency personal Breathing Apparatus for POB to be provided and suitably stored for easy access inside the TR



Breathing Apparatus System 2/2



CCTV Systems



A CCTV system will be installed inside to enable the TR control room operators to monitor the situation during the emergency mustering of personnel inside the TR, and provide adequate response and instructions accordingly.



ATEX CCTV Camera

PA/GA & Intercom Systems

PA/GA Access Point (Public Address/General Alarm) – PA/GA systems to be fitted and audible in all areas of the TR and externally to the barge main deck area.

A wall mounted Access Unit will be provided in the TR. The unit will be provided with push buttons to manually initiate the general alarms, push buttons to allow emergency voice messages to be sent to individual or all areas of the vessel.

Intercom System - Telephone Access Point and Telecoms facilities in the TR: a telephone will be provided in the TR to enable personnel to speak directly with the other telephone points located throughout the vessel and the offshore facilities (e.g. Control Room and the telephone access point located close to the Muster Point/Emergency Evacuation Area).



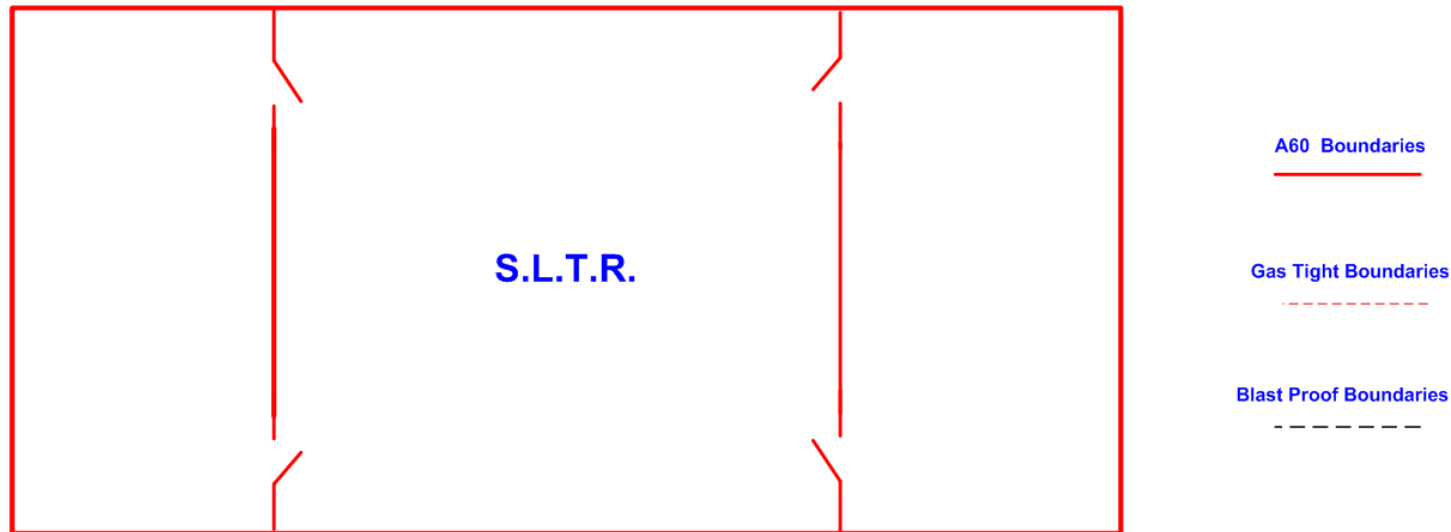
“Short-Lasting” Temporary Refuge

“SHORT-LASTING” TEMPORARY REFUGE

The Basic Temporary Refuge (S.L.T.R.) is a safe area for **short-lasting** people protection during environmental contamination from poisonous gases which can be present in operating areas where oil and/or gas research, extraction and pre-production are performed.

The **environmental conditions inside T.R. are constantly monitored to avoid the presence of contaminated air.**

“Short-Lasting” Temporary Refuge typical layout



The Short-Lasting temporary refuge consists in:

- a large area able to contain the personnel on board the minimum surface of this area will need to be about 1,5 sq.m per person
- no airlocks equipped without air washing systems and interlocked doors
- no fully recirculated emergency air conditioning system

S.L.T.R. typical Emergency equipment

Emergency personal Breathing Apparatus for POB to be provided and suitably stored inside the Short-Lasting Temporary Refuge (S.L.T.R.).

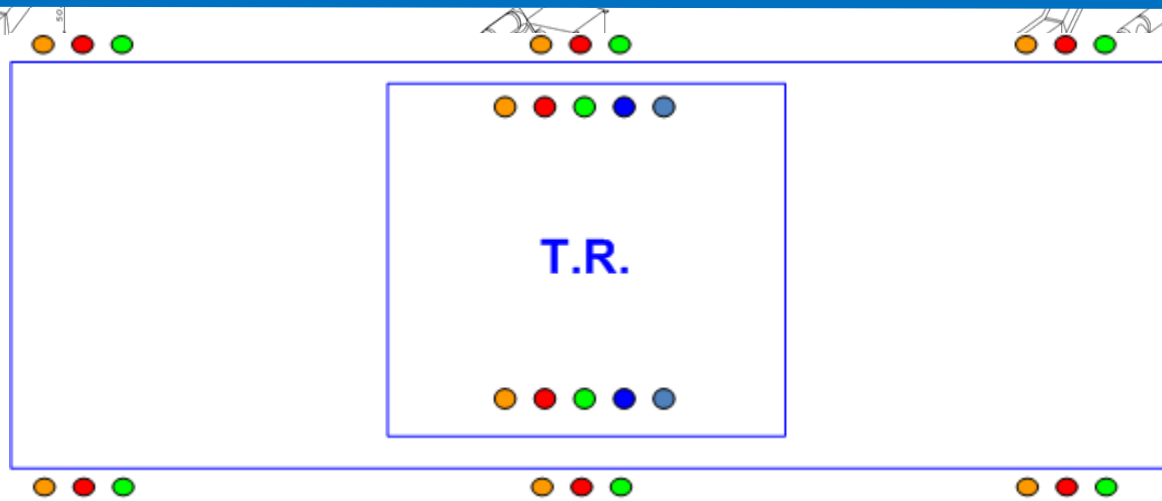
Air will be provided by systems of high pressure air bottles. The storage system is made up with litres high pressure bottles with first and second stage pressure reduction stations, distribution system, air compression system to ensure the capacity of filling the bottles with clean air.

The air supply system is based on two 100% back-up modules.

Short-Lasting Temporary Refuge (S.L.T.R.) will also be equipped with the following safety systems:

- **TR Control/Command Panel including Gas Level Monitoring Console and the residual level of air inside the air bottles of the TR system**
- **Gas detectors**
- **Telephone Access Point**

S.L.T.R. Typical sensors positioning



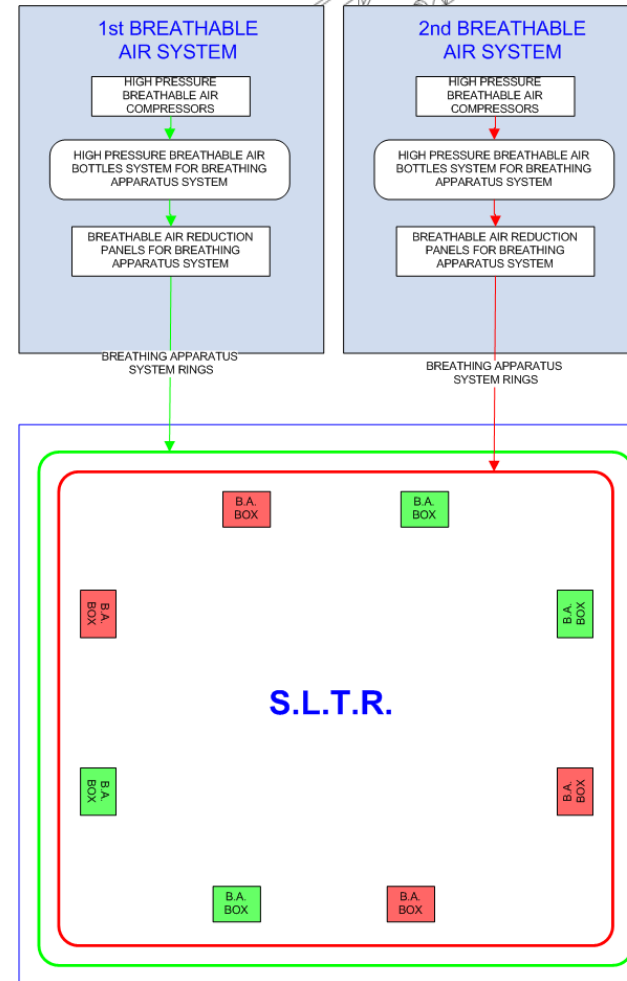
- SO2 sensor
- CH4 sensor
- H2S sensor
- CO2 sensor
- O2 sensor

Sensors arrays can be equipped with one or three sensors of each type according to requirements.

When two or more sensors of the same type read high values of gas the alarm status is achieved and emergency procedure is started

S.L.T.R. Breathing Apparatus System

Emergency personal Breathing Apparatus for POB to be provided and suitably inside the TR





Thanks for Your Attention!

REFERENCE CONTACTS

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